The Characteristics of Road Traffic Fatalities in Kazakhstan's Semey Region, 2006-2010: A Descriptive Retrospective Study

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Abstract

Background: Kazakhstan, a developing middle-income country, has the highest road traffic collision (RTC) mortality in the European Region. The aims of this study were to determine main characteristics of road traffic fatalities in Semey region, Kazakhstan and to compare findings with National data and middle-income European countries.

Methods: This descriptive surveillance study assesses RTC mortality rates and epidemiology in the Semey Region of East Kazakhstan Oblast. Data of all 318 road traffic fatalities form the Semey Regional Center for Forensic Medicine were analyzed for the 5-year period of January 1, 2006 through December 31, 2010.

Results: Over the study period, the average road traffic mortality in the Semey Region was 12.1 per 100,000 population with downward trend by 35.1% (p=0.002). The victims mean age was 37.1 (SD=17) years. Males predominated at 74.5%. Vehicle fatality was the most common mode of fatality at 61.3%. The majority of collisions, 53.1%, occurred on highways. Most victims, 67.3%, have died at the scene of collision; in 67.3% of fatalities, autopsies identified multiple injuries as cause of death. The high number of fatal collisions took place in "no snow" season (*P<0.001*), with an overall 5-years downward dynamic.

Conclusion: High proportion of males, pedestrians and car occupants among road traffic fatalities; high proportion of death on scene in case of highway collisions are specifics for Semey region, Kazakhstan. These findings can be used to formulate preventive strategies to reduce fatalities and to improve the medical care system for road traffic fatalities.

Keywords: Road traffic fatality, Epidemiology, Accident, Kazakhstan

Introduction

In the European region (ER), road traffic collision (RTC) results in almost 120,000 fatalities and 2.4 million injuries each year (1) and are the leading cause of death among adolescents and young adults. The mortality rate from road traffic injuries (RTIs) in the ER is 13.4 per 100,000 population, which is lower than the global rate of 18.8 per 100,000. However, in low- and middle-income countries, the rate of RTIs is 18.7 per 100,000, or more than twice as high as the 7.9 per 100,000 rate found in high-income countries.

In Kazakhstan, a developing middle-income country, RTC is the second leading cause of death (2). According to the WHO, Kazakhstan has the highest rate of road traffic mortality (30.6 per 100,000) in the ER (1). This rate is 2 times higher than the

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average rate in middle-income countries, and 9.5 times more than San Marino, the safest country of Europe. It is well known that developing of road traffic safety policy anywhere is required detailed information about structure of RTC and their victims and fatalities. Unfortunately, there is gap of knowledge about road traffic mortality in Kazakhstan. For example, the World Health Organization's European Status Report on Road Safety (1) has lack information about trends in RTC deaths, age-specific mortality rates related to RTIs, or deaths by mode of collision rates in Kazakhstan (pp. 82-83). The result of Harvard University Road Injury Metrics project have published, but these data were preliminary and studied year was 2005 (3). The only published article about road traffic mortality in Kazakhstan was published this year and focused only on National level demographic data such as age and gender of victims (4).

We aimed to study more profound characteristics of RTC fatalities such as seasonality of fatal RTC, cause of death, location of fatal RTC, time of death and mode of collision in addition to age and gender on the sample of Semey region, Kazakhstan; and compare them with National and middle-income ER data. These data might be a scientific basis of future road traffic safety policy.

Materials and Methods

Location
Kazakhstan consists of 14 provinces, or "oblasts," and two cities with state status: Astana, Kazakhstan's capital, and Almaty. Research was performed in the Semey Region of East Kazakhstan Oblast with an average population of 526,133 from 2006-2010 (table 1) and comprises 37.2% of the total population of East Kazakhstan Oblast.

Table 1: Road traffic fatality in the Semey Region, 2006-2010

Year	2006	2007	2008	2009	2010	Total 5-years
Total number of road traffic fatalities	81	72	50	62	53	318
General population	524,258	524,765	524,747	527,139	529,756	2,630,665
Road traffic fatality per 100.000 population	15.4	13.7	9.5	11.8	10.0	12.1

Design
The design of the study is descriptive (passive surveillance). According to (5) "surveillance is important type of descriptive study. Surveillance can be thought of as watchfulness over a community. Passive surveillance relies on data generally gathered through traditional channels, such as death certificates". In our case we retrospectively collected data of road traffic fatalities that had died in Semey Region in 5-year period from January 1, 2006 through December 31, 2010.

Database
Total numbers of autopsied fatalities were 3591 at the Semey Regional Center for Forensic Medicine (SRCFM) from January 1, 2006 to December 31, 2010. Autopsied fatalities after injury were 1803, including 318 victims after fatal traffic collisions

that occurred in the Semey Region. The autopsy protocols of road traffic fatalities were made by licensed pathologist according to standard protocols of Ministry of health of Republic of Kazakhstan. Data of all of them were extracted and included in this study. There were not missing data.

Data access
Generally, the clinical Departments of Medical Universities in Kazakhstan are located in Medical Organizations with the educational aim, where the faculty members work together with stuff of Medical Organizations (doctors, specialists, et.al.).
Department of Forensic Medicine is structural part of Semey State Medical University (SSMU). At the same time, it is located in the SRCFM. The faculty members of Forensic Medicine Department work together with SRCFM pathologists on

the daily bases and archive data of SRCFM are the result of their collaborative work. So the faculty members of Forensic Medicine Department have legally right to access data. In addition, before research had been started, the Academic Council of SSMU had approved the access to this data.

Including criteria

The case of death related to traffic collision during 5-year period from January 1, 2006 to December 31, 2010 and registered by road police.

Variables

Data underwent subsequent analysis based on the following variables with the way of data verification:

• Age (abs., year) – police report or victim's driver license or ID card or relatives' testimony;

• Gender (abs., male / female) - forensic pathologist;

• Seasonality of fatal RTC (abs, month of year) - police report;

• Cause of death (abs., cases of multiply injury, head injury etc.) - forensic pathologist (determination of main fatal injury);

• Location of fatal RTC (abs., urban, rural areas or highway) - police report;

• Time of death (abs., at the scene of collision, during transportation to a hospital, after treatment in a hospital, other place) - police report and conclusion of forensic pathologist.

Mode of collision

It classified by type of motor vehicle involved in the RTC. Classification modes of collisions are based on the Road Traffic Act (6) utilizing the following definitions:

- Class 1: Pedestrian or cyclist fatalities, due to their common characteristic as "unprotected" individuals.

- Class 2: Drivers and passengers of motorcycles, scooters, and motorized vehicles with less than four wheels that weigh less than 400 kg when unladen.

- Class 3: Drivers and passengers of vehicles that weigh less than 2500 kg and carry no more

than seven passengers exclusive of the driver; or in any other case, motor vehicles that do not exceed 2500 kg, such as cars, taxis, pick-ups, vans, minibuses or SUVs.

- Class 4: Drivers and passengers of vehicles designed to carry a load of more than seven passengers with an unladen weight exceeding 2500 kg.

- Class 5: Victims who died under a vehicle's wheels, as such injuries are extremely severe and tend to be fatal.

Other demographic data, including the number of population in the region were gathered from the regional government's statistical department website (7).

Potential source bias and confounders

In general our data were simple (gender, date of collision, location of collision etc.) and is difficult to confuse them. The numbers of population were taken from official site of Oblast government. During the study we have assumed the following confounders and ways of their minimization:

1. Not traumatically cause of death – in difficult cases conclusion (pathological diagnosis) is made by two forensic pathologists collegially to approve or exclude traumatic genesis of death;

2. Misspelling of mode of collision in protocol by traffic police officer - Information of victim's mode of collision were extracted from police report and verified by forensic pathologist based on typically injuries for different category of road users. So this data were verified twice.

3. Missing of collision's registration - The Kazakhstan Ministry of Healthcare (8, 9) requires all cases of violent deaths, including road traffic death, to be autopsied at the Regional Centers for Forensic Medicine.

Ethical consideration

All data were coded and couldn't be identified by anyone except researchers. Furthermore the research has been approved by the Local Ethics Committee of Semey State Medical University (protocol # 2, 24.10.2012).

Statistical analysis

Data were presented by frequencies and percentages for qualitative variables and mean (SD) for quantitative variables. Road traffic mortality was calculated as proportion of total number of road traffic fatalities of each year and number of general population of Semey region at that year multiplied by 100,000. Incidence of different age groups fatalities was computed as proportion of number of victims of each age group and number of Semey region's population at this age group multiplied by 100,000. Chi-square was used to establish the seasonality of RTC mortality in relation to "snow" and "no snow" year seasons and mortality trend (2010 vs. 2006). Statistic data analysis was performed by Stata software, version 11.0 (Stata, College Station, TX, USA).

Results

Figure 1 presents the flow chart of the study design. It shows that total number of fatalities that were autopsied in SRCFM were 3591. From 1803 fatalities after injury only 318 cases had been indicated as after RTC by police officer and forensic pathologist when they entered our study.
Over the 5-year study period, the average road traffic mortality in the Semey Region was 12.1 per 100,000 population. The RTC mortality decreased by 35.1% (*P*=0.002) from 15.4 in 2006 to 10.0 per 100,000 population in 2010 (Table 1).

Demographics

The distribution of road traffic fatalities by age was skewed towards younger age groups. The mean age of victims in the sample was 37.1 years (Median = 35, Q1 = 24, Q3 = 47). The highest proportion of 25.5% amount total road traffic fatalities in the 20 to 29 year-old range (table 2). Notably, 269 (84.6%) of victims were in the economically productive age range of 16 (legal age to start working) to 58 (official retirement age) for women (n=59) and to 63 years for men (n=210) (10). Incidence of fatal crashes in different age groups of population had two peaks (Table 2). The first occurred in the group of 20-29 year olds due to Class 3 fatalities, while the second was ob-

served among 50-59 year olds due to Class 1 fatalities (data not shown).
Three-fourths (74.5%) of RTC fatalities were male (n=237), and one-fourth (25.5%) were female (n=81). The male to female ratio was 2.93:1.
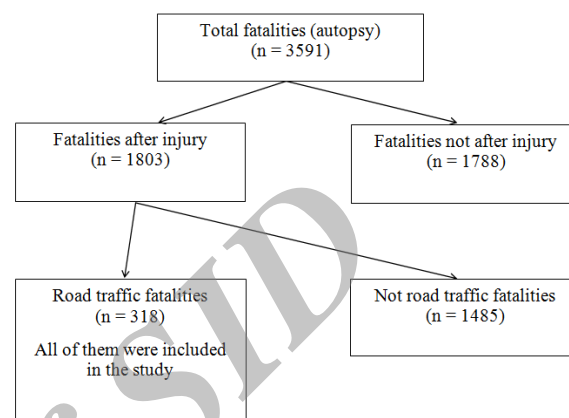

Fig. 1: The flow chart of the study design

Mode of collision

Over the 5-year span of the study, Class 3 fatalities were most prevalent, comprising 61.3% of total fatalities as illustrated in Table 3. This study was unable to determine the number of drivers and passengers in Class 3 fatalities precisely, due to lack of specific data in autopsy protocols. Class 1 fatalities, or those, involving pedestrians and cyclists comprised 29.6% of total fatalities. Of these, 92 were pedestrians (28.9% of total fatalities) and two were cyclists (0.7% of total). Altogether, Class 2, Class 4 and Class 5 fatalities did not exceed 10%. In four cases, the mode of fatality could not be established due to lack of information in police report and atypically fatal injuries.
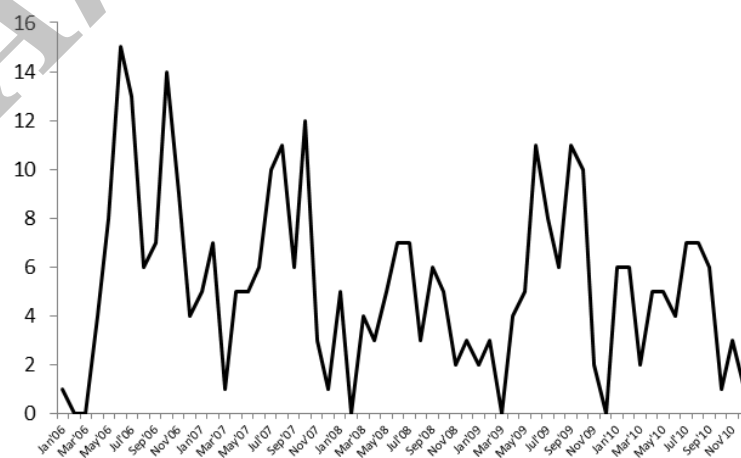
Seasonality

We defined the seasonality of fatal RTCs (Fig. 2). The number of fatal RTC in "no snow" season (from May to October) was higher than in "snow" season (from November to April) (*P*<0.001). Annually, RTC fatalities reached a peak in the months of July, August and September, with overall 5-years downward dynamic.

Table 2: Age distribution of RTC fatalities, 2006 - 2010 (abs. numbers)

Age group (yr)	2006	2007	2008	2009	2010	Total abs	Total %	Gender (% of total) Male	Gender (% of total) Female	Incidence of RTC fatalities per 100,000 population, 2010
0-9	3	4	5	0	2	14	4.4	2.2	2.2	2.1
10-19	5	3	4	7	6	25	7.9	4.7	3.1	7.3
20-29	25	17	13	12	14	81	25.5	21.7	3.8	14.2
30-39	16	16	10	15	10	67	21.1	17.9	3.1	12.9
40-49	15	13	5	16	9	58	18.2	12.9	5.3	12.9
50-59	9	9	4	5	8	35	11.0	7.2	3.8	14.6
60-69	5	5	4	4	3	21	6.6	4.7	1.9	11.1
≥70	3	5	5	3	1	17	5.3	3.1	2.2	3.9

Table 3: Distribution of location of fatal RTC, victim's death and mode of collision, 2006 - 2010 (abs. numbers)

	2006	2007	2008	2009	2010	Total abs	Total %
Mode of collision							
Class 1	29	22	14	18	11	94	29.6
Class 2	1	1	1	2	1	6	1.9
Class 3	48	45	32	38	32	195	61.3
Class 4	2	0	3	1	4	10	3.1
Class 5	1	3	0	1	4	9	2.8
Unknown	0	1	0	2	1	4	1.2
Location of fatal RTC							
Urban area	31	28	18	20	19	116	36.5
Rural area	7	2	6	9	7	31	9.7
Highway	42	42	26	33	26	169	53.1
Other	1	0	0	0	1	2	0.6
Location of victim's death							
At the scene	56	49	34	38	37	214	67.3
Transportation to a hospital	2	0	3	4	0	9	2.8
Hospital	23	23	13	20	15	94	29.6
Other	0	0	0	0	1	1	0.3

Fig. 2: Seasonality of RTC fatalities of Semey region by months, 2006-2010 (abs. numbers)

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Cause of Death

Most RTC fatalities in the sample - 67.3% - were caused by multiple injuries, defined as an injury involving two or more body regions. In most cases, affected body regions included the head, chest, abdomen, organs or extremities. At 21.4%, the second most prevalent cause of death was isolated head injury, predominantly presented as cranial bone fractures, brain injury, and intracranial hematomas. At 5.3%, the third most prevalent cause of death was isolated chest injuries. Spine injuries were the cause of death in 3.5% cases. Other fatal injuries were less common; none exceeded 2.4%, including sepsis (0.9%), abdominal injury (0.6%), thromboembolism, fat embolism (0.6%), and burns (0.3% cases).

Location of Fatal RTC

As illustrated by Table 3, 169 cases or 53.1% of fatal accidents occurred on a highway. This comprised the largest location group in the sample. Collisions in urban and rural areas were less common, measuring 36.5% and 9.7% respectively.

Location of victim's death after RTC

The majority (67.3% or n=214) of victims of fatal RTC died at the scene of collision, as illustrated in Table 3. Ninety-four victims, or 29.6%, died in the hospital following treatment. Nine victims, or 2.8%, died in an ambulance or car while being transported to a hospital. One victim died at home the night after being involved in an RTC.

Discussion

The aim of this study was to generate basic epidemiological data and main characteristics of road traffic fatalities in Semey region and compare with National and ER middle-income countries data.

At present, road traffic collisions are the second leading cause of death in Kazakhstan (2). Moreover, according to the WHO, Kazakhstan has the highest rate of road traffic mortality in the ER (1).

Differences with other studies

Although, the demographic distribution of fatalities (sex, age groups) in our research were con-

sistent with National data (4), but surprisingly, road traffic mortality in Semey region (12.1 per 100,000) was much more lower than average in Kazakhstan (20.3-32.2 per 100,000) (1,4). This could be partially explained by the differences in administrative and territorial characteristics of the Kazakhstan's regions, such as socio-demographic characteristics, quality of roads and other factors related to roads, etc. (4). We presume that other factors, such as lower traffic density and longer snow season in Semey region, might also influence to this difference.

After comparing with ER middle-income countries, we found the opposite relation than in National level: road traffic mortality data are similar to European middle-income countries such as Czech Republic (12.0), Hungary (12.3), Romania (12.7) (1), and the demographic distribution is somewhat different. For example, our data shows that a majority of victims were male (74.5%), which is slightly higher with the findings of K. Toro et al. (11) and G. Cãlinoiu (12), who found that in Hungary and Romania, 69% and 69.1% of fatalities were male. We presume that the proportion of male victims in our study was higher than in Europe, because the majority of drivers in Kazakhstan are males.

The other difference with ER is class fatalities. Class 1 and Class 3 fatalities (29.6% and 61.3% of the total number, respectively) are two of the most frequent fatalities in Semey Region. The ER has lower pedestrian death proportion as compared to Kazakhstan: Czech Republic (19%), Hungary (23%), Romania (11%) (1). The high proportion of pedestrian mortality in Semey region could be attributed to the insufficient number of hinged crosswalks and underpasses in urban areas that help to isolate the pedestrians from traffic. Moreover, by our observation, pedestrians tend to cross the road at an undisclosed location as distance from one zebra to another is more than 80-100 meters even in center of the city. Class 3 fatalities rate (drivers and passengers) in Semey region was higher than in Poland (51%), Hungary (55%), and Czech Republic (59%) (1). We attribute it with dangerous behavior of drivers (aggressive driving, disregard of speed mode and drunk driving).

The other differences with ER middle-income countries are related to highway's mortality. In the Semey Region, the majority of fatal RTCs (53.1%) took place on highways. In comparison, this rate was higher than in Romania (12). In Semey region the quality of road surface on highways is less than satisfactory; the width of the roadway is such that cars have to come too close to each other, especially in winter, when the edges of roadway are covered with snow. In most cases the highways with counter direction have no allocated strips for unilateral movement, which often leads to frontal collisions at high speed.

The most common death setting in this study was at the scene of collision (67.3%). This is significantly higher than in the Hungarian study which found that 48.6% of RTC fatalities took place at the scene of the accident, while 49.4% of victims died after medical treatment was provided (11). As the majority of fatal accidents in the Semey Region occurred on highways, the geographic size of our area and absence of medical helicopters may have had a negative impact on the timely provision of medical care and contributed to the number of people died.

This study established the seasonality of fatal RTCs in the Semey Region, suggesting a summer-autumn peak. This seasonality finding might be as a result of increased vehicles number and average speed of vehicles on the dry roads of summer and autumn seasons, as in 5-6 months snowy winter many drivers prefer public transport. Highway usage is also dramatically increased during summer-autumn season. This also might explain the lower fatal RTC comparing to National level, as in many dens-populated areas of Kazakhstan snowy winter season is much shorter.

Similarities with other studies

Despite above mentioned differences from ER middle-income countries, we found some similarities too. Young victims comprise the most proportion, 64.8% of RTC fatalities fell in the age range from 20 to 49 years (table 2), which is a great loss for the community and the National economy. Similar findings were observed in the other European countries (1,11,13,14).

Multiple injuries (67.3% of the total) and head trauma (21.4%) prevailed as the most common causes of death in Semey region. Unfortunately, we couldn't find data from ER middle-income countries to compare with.

In spite of uniform road safety legislative system in Kazakhstan, Semey region RTC fatality is much lower than National level. Causes of this difference, such as population and traffic density, climatic differences, should be analyzed in future studies.

The recommendation for policy making

Based on results of this research and previous studies in this area (15-29), we propose following preventive measures in Kazakhstan that have been effective in improving the road safety in other countries:

1.   In Kazakhstan, the cheapest and most common mode of transport is a car. The distance between the cities ranges from 200 to 500 km. Speed control in these areas is not yet well organized. This could be reason for the high mortality on highways. Furthermore among died pedestrians were children. So controlling the vehicle speed on highways and city roads, especially near schools and child-care centers might be effective (15-18).

2.   Vehicles of emergency medical services are far away due to long distance between cities, and the time between the call to the emergency services and the arrival of emergency aid to scene of collision is in average about 40 minutes (data calculated by us, not shown in this study). So, improving the system of emergency medical aid to the victims of road accidents, optimizing the ambulance service, introducing the medical helicopters into daily practice (19) are important measures of minimization of collision aftermaths.

3.   Considering that in our study highest proportion of road traffic fatalities in the 20 to 29 year-old range, revealing the factors of risky behavior of pedestrians and drivers, especially young drivers, might be useful in the development of preventive programs (20-25).

4.   Development of road infrastructure in Kazakhstan is not adequate to dramatically in-

creased vehicle fleet. Improving the infrastructure of urban roads and highways together with identification of local hazardous road locations that have been verified and mapped out using the Geographic Information System (26-29) might be effective for increasing of road safety.

We believe if effective countermeasures would be introduced in Semey region the road traffic mortality could be declined much more than current level. The future researches should be focused on determination of risk factors and development road safety policy framework.

Strengths and limitations of this study

Strengths

● All fatal road traffic collision cases of Semey region during 5-years period were included into the study.

● Five-year time period is generally accepted to be sufficient for the evaluation of epidemiological situation.

Limitations

● This study was not designed to explore the risk factors leading to lethal outcome.

● Comparison limited to National data and middle-income European countries.

Generalizability of data

Generalizability of our data for Kazakhstan should be careful due to power and design of study, climate and social-demographical differences in other Kazakhstan's Oblasts. Our results would be useful for developing of road traffic safety policy in Semey region and East Kazakhstan Oblast.

Conclusion

Lower road traffic mortality and prominent seasonality in Semey region comparatively to National level; higher proportion of males, pedestrians and car occupants among road traffic fatalities; high proportion of death on scene in case of highway collisions comparatively to ER middle-income countries - are specific for Semey region, Kazakhstan. These data could be useful for determining of risk factors in development of road safety policy framework in Kazakhstan.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

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